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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/825,078	04/15/2004	William F. Northrop	3402.1019-001	7170

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EXAMINER	
MERKLING, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/825,078	NORTHROP ET AL.	
	Examiner	Art Unit	
	Matthew J. Merkling	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 November 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-29* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/ are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 3, 24 and 27 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. In the amended claims 1, 11 and 25, Applicant added the limitation "wherein reformate enters the fluid flow path and is heated by heat exchange with the carrier prior to flowing into the at least one fuel reformer module". There is no basis in the originally filed disclosure that indicates flowing a reformate (product of a reforming reaction) into a subsequent reforming catalyst. In other words, in claims 3, 24 and 27, Applicant lists one of the catalysts contained in the module comprises a "reforming catalyst". Nowhere in the specification does Applicant disclose sending a reformate (which is the product of a reforming catalyst (see specification page 7, lines 14-21) stream to another reforming catalyst.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. Claims 1-8, 11 and 25-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hotta et al. (US 2005/0129593) in view of Bentley et al. (US 7,066,973).

Regarding claims 1-3, 11, 25, 27 Hotta discloses a modular reactor (Fig. 1) comprising: a reactor assembly comprising a cavity (inside of shell 6); a removable carrier (reactor is detachable from the shell, see paragraph 52) comprising at least one reactor module (catalyst 2, heating exchanger tubes 12), the carrier (2, 12) connecting to the reactor assembly (6) to enclose the at least one module within the cavity (see Fig. 1), the carrier carrying at least a portion of the at least one reactor module in an interior portion (see Fig. 1), an exterior portion of the carrier and walls of the cavity forming a fluid flow path to the interior portion of the carrier (see flow path of incoming fluid in Fig. 1 where it passes along the outside of reaction zone 2, and exchanges heat therewith)

wherein reactant enters the fluid flow path (7a) and is heated by heat exchange with the carrier prior to flowing into the at least one reactor module (fluid is heated by carrier prior to entering reaction zone in Fig. 1); and

a connector engageable to secure the carrier and the reactor assembly (via flange 4) in fluid-tight relationship along with a gasket (paragraph 51).

Hotta teaches a generic reactor that integrates a heat exchanger, a heater, and a reaction space which is designed to utilize the heat from the reaction to assist in the preheating of the incoming reactants (see abstract, and Fig. 1 flow diagram). Hotta, however, does not explicitly disclose said reaction as being used in the service of a reforming reactor to produce hydrogen.

Bentley also discloses a reactor that efficiently utilizes heat in an integrated reactor (see abstract).

Bentley teaches an integrated reformer and gas-shift reactor that utilizes heat from reaction as well as provided heat (via combustion) in order to provide a compact reactor design that can be used to provide fuel to a fuel cell (see abstract, col. 1 lines 27-37).

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to take the generic reactor design of Hotta, which integrates heat exchange into the reaction, and add the reforming catalyst of Bentley in order to provide a compact reactor design that produces hydrogen for a fuel cell.

Regarding claim 4, Hotta further discloses a portion of the removable carrier comprises a portion extending outside of the cavity (see Fig. 1 where heat exchange portions 7b and 7a are located outside of the cavity).

Regarding claim 5, Hotta further discloses the carrier and walls of the cavity are generally cylindrically shaped and the carrier fits concentrically within the cavity (see Fig. 1B) and the fluid flow path is an annulus between the carrier and the walls of the cavity (see flow path of fluid in Fig. 1).

Regarding claims 6 and 7, Hotta further discloses a flange (4) that connects a surface of the fuel reformer assembly to connect the carrier to the fuel reformer assembly (see Fig. 1) and a gasket positioned between the flange and the surface of the fuel reformer assembly (paragraph 51).

Regarding claims 8 and 26, Hotta further discloses the connector comprises a bolt (paragraph 52).

Regarding claim 28, Hotta further discloses a heat exchange module in the carrier (see Fig. 1 and abstract).

Regarding claim 29, Hotta further discloses the catalyst is supported on a monolithic substrate or is in palletized form (col. 13 lines 35-45).

6. Claims 1-3, 11, 19, 25 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hotta et al. (US 2005/0129593) in view of Deshpande (US 2002/0090328).

Regarding claims 1-3, 11, 25 and 27 Hotta discloses a modular reactor and method for improving serviceability of said modular fuel reformer (Fig. 1)

comprising: a reactor assembly comprising a cavity (inside of shell 6); a removable carrier (reactor is detachable from the shell, see paragraph 52) comprising at least one reactor module (catalyst 2, heating exchanger tubes 12), the carrier (2, 12) connecting to the reactor assembly (6) to enclose the at least one module within the cavity (see Fig. 1), the carrier carrying at least a portion of the at least one reactor module in an interior portion (see Fig. 1), an exterior portion of the carrier and walls of the cavity forming a fluid flow path to the interior portion of the carrier (see flow path of incoming fluid in Fig. 1 where it passes along the outside of reaction zone 2, and exchanges heat therewith) wherein reactant enters the fluid flow path (7a) and is heated by heat exchange with the carrier prior to flowing into the at least one reactor module (fluid is heated by carrier prior to entering reaction zone in Fig. 1); and

a connector engageable to secure the carrier and the reactor assembly (via flange 4) in fluid-tight relationship along with a gasket (paragraph 51).

Hotta teaches a generic reactor that integrates a heat exchanger, a heater, and a reaction space which is designed to utilize the heat from the reaction to assist in the preheating of the incoming reactants (see abstract, and Fig. 1 flow diagram). Hotta, however, does not explicitly disclose said reaction as being used in the service of a reforming reactor to produce hydrogen.

Deshpande also discloses a reactor that efficiently utilizes heat in an integrated reactor (see abstract).

Deshpande teaches an integrated reformer (224) and gas-shift reactor (228) and preferential oxidation reactor (230) that utilizes heat from reaction as well as

provided heat (via combustion in the autothermal reformer 230) in order to provide a compact reactor design that can be used to provide fuel to a fuel cell (see abstract, paragraph 5). Also, Deshpande discloses arranging these reaction sections (224, 228, and 230) concentrically around each other in order to provide efficient heat exchange between the reaction sections (paragraph 42) as well as introducing the feed stream (214+212+216) into the module (30) to be in thermal contact with the outside surface of the reforming section prior to introducing it into the reforming section (which is similar to the introduction method of a reactant stream into the module of Hotta).

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to take the generic reactor design of Hotta, which integrates heat exchange into the reaction, and add the reforming catalyst, gas shift catalyst and preferential oxidation catalyst of Deshpande in order to provide a compact reactor design that produces hydrogen for a fuel cell.

Regarding claim 19, Hotta further discloses the connector comprises a bolt (paragraph 52).

7. Claims 1-7, 9-18 and 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Deshpande (US 2002/0090328) in view of Hermann et al. (US 6,780,292) as evidenced by Edlund (US 2001/0045061).

Regarding claims 1-4, 11, 15-18, 20-22 and 24, Deshpande discloses a modular fuel reformer and method for improving serviceability of said modular fuel reformer comprising: a fuel reformer assembly (30) comprising a cavity; a

carrier (224 and 220) comprising at least one fuel reformer module (224), the carrier connecting to the fuel reformer assembly to enclose the at least one module (see Fig. 3 where reforming module 224 is enclosed by 226, 228 and 230), the carrier carrying at least a portion of the at least one fuel reformer module (224) in an interior portion (see Fig. 3), an exterior portion of the carrier (defined by heat transfer fins 220) and walls of the cavity forming a fluid flow path to the interior portion of the carrier (see Fig. 3 where fluid enters the fuel reformer assembly and then flows between the heat transfer fins, which define the outside of the carrier 224, and the inside of a cavity defined by zone 226) wherein reactant enters the fluid flow path and is heated by heat exchange with the carrier prior to flowing into the at least one fuel reformer module (paragraph 45); and

While Deshpande teaches a fuel reforming apparatus and method that forms a integrated compact fuel processor to produce hydrogen for such applications as a fuel cell, Deshpande fails to disclose the carrier which contains the reforming module to be removable and to comprise a connector engageable to secure the carrier and the fuel reformer assembly in fluid-tight relationship and disengageable to permit removal of the carrier from the fuel reformer assembly. However, it was well known in the art at the time of the invention that in a fuel processor, such as the one disclosed by Deshpande, the reforming catalyst occasionally needs to be replaced (see paragraphs 4, 59 and 61 of Edlund which discloses a fuel processor with individual components that can be

replaced quickly by using a modular form for these components, including a reforming catalyst).

Hermann discloses a reaction apparatus that is designed to facilitate quick and easy transfer of reactor components in and out of a reaction shell.

Hermann teaches a carrier/cartridge (98) that is contained in a cavity (inside vessel housing 102) where the outside of the carrier and the inside of the cavity walls form a fluid flow path (see Fig. 9 where cartridge 98 forms a fluid flow path with the inside of the cavity walls between inlet 108 and outlet 110). Hermann teaches this configuration as a preferable means of quickly and easily replacing a reaction component when a reaction component in said cartridge is deactivated (col. 9 lines 33-45).

As such, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize the reactor cartridge module of Hermann, in the fuel processor of Deshpande and make the reforming module of Deshpande a removable cartridge in order to facilitate and quick an easy exchange of the reforming module when the catalyst requires changing.

Regarding claim 5, Deshpande further discloses the fuel processor apparatus discussed in claim 1 above, is of a cylindrical shape (paragraph 48).

Regarding claims 6 and 7, Deshpande, as modified by Hermann above, further discloses a flange on the carrier that is sealed to the fuel reformer assembly with a gasket (see Fig. 9 and col. 5 lines 51-54 of Hermann).

Regarding claims 9 and 10, Deshpande, as modified by Hermann above, further discloses a gas shift catalyst in the module (228) and a preferential oxidation catalyst (230) in the fuel reformer cavity.

Regarding claims 12 -14, Deshpande further discloses said catalyst may comprise a palletized catalyst or a monolithic catalyst (paragraph 5).

Regarding claim 23, Deshpande, as modified by Hermann above, teaches a half portion of the carrier contains the catalyst and the other half is a plate holding the catalyst in place (see Fig. 4 of Hermann).

Response to Arguments

8. Applicant's arguments with respect to claims 1-29 have been considered but are moot in view of the new ground(s) of rejection necessitated by amendment.

Conclusion

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory

action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Merkling whose telephone number is (571) 272-9813. The examiner can normally be reached on M-F 8:30-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MM

MJM

Alexa Neckel

ALEXA D. NECKEL
SUPERVISORY PATENT EXAMINER